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(54) LASER WELDING METHOD FOR ZINC-PLATED STEEL SHEET.

(57) This invention relates to a laser welding method for a zinc-plated steel sheet for welding zinc-plated steel sheets to one another or a zinc-plated steel sheet to a sheet of other metal by laser. An intermediate layer (7) for limiting the evaporation of zinc is formed between the zinc-plated steel sheets (1, 4) or between the zinc-plated steel sheet (1) and the sheet of other metal and laser welding is conducted by applying a laser beam (8) to the zinc-plated steel sheet (1) or to the sheet of other metal. As a result, the occurrence of porosity can be prevented and the bead (9) has a constant width.

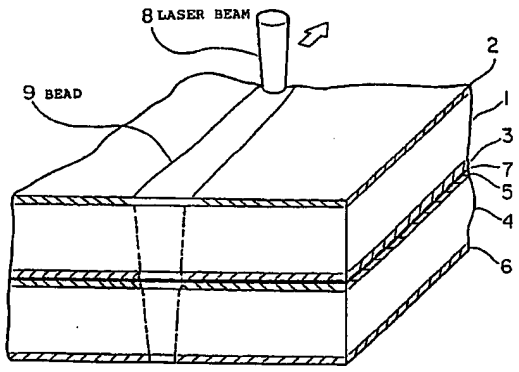

Fig. 1

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Technical Field

The present invention relates to a method of welding a galvanized steel sheet with a laser beam, and more particularly to a method of welding a galvanized steel sheet with a laser beam while preventing porosity and weld bead defects including surface craters that are formed by an evaporated gas.

Background Art

Welding metals with beams of high energy density (heat source), typically laser beams, is used in a wide range of metal welding applications since the welding process is clean, has a high degree of freedom, and can minimize thermal strains. Particularly, the laser beam welding process for metals finds growing use in the automobile industry or the like as a composite machining system composed of a laser oscillator and a numerically controlled apparatus or robot.

Automobiles employ a number of corrosion-resistant galvanized steel sheets as a highly durable material in their frames and other components. There is a demand for welding galvanized steel sheets with a laser beam.

FIG. 2 of the accompanying drawings shows a conventional process of welding galvanized steel sheets with a laser beam. A galvanized steel sheet 1 has plated zinc layers 2, 3 deposited on its opposite surfaces, and another galvanized steel sheet 4 also has plated zinc layers 5, 6 deposited on its opposite surfaces. When a laser beam 8 is applied to the galvanized steel sheets 1, 4 to weld them, a weld bead 10 is formed as a result of a weld pass.

Steel has a melting point of about 1545°C and a boiling point of about 2754°C, whereas zinc has a melting point of 420°C and a boiling point of 903°C. Because of the heat produced by the high-density energy of the applied laser beam, the zinc with a lower melting point is violently evaporated into a gas, thereby forming porosity (cavities) 11a, 11b, 11c in the weld bead 10. While only the surface porosity is shown, porosity is also formed within the weld bead 10. As a result, the weld bead 10 has irregular width dimensions, and the welded joint is rendered brittle. For the reasons described above, it has been infeasible to weld galvanized steel sheets with a laser beam.

Disclosure of the Invention

In view of the aforesaid drawbacks of the conventional laser beam welding method, it is an object of the present envention to provide a method of welding a galvanized steel sheet with a laser beam while preventing porosity and weld bead defects.

To solve the above problems, there is provided a method of welding galvanized steel sheets to each other or a galvanized steel sheet and a sheet of another metal to each other with a laser beam, comprising the steps of forming an intermediate layer for suppressing evaporation of zinc, between said galvanized steel sheets or said galvanized steel sheet and said sheet of another metal, and applying a laser beam to said galvanized steel sheet or said sheet of another metal, thereby welding the sheets with the laser beam.

As a consequence, zinc layers are prevented from being violently evaporated. Porosity is prevented from being formed in a weld bead, and the weld bead has a constant width.

Brief Description of the Drawings

FIG. 1 is a fragmentary perspective view showing a method of welding galvanized steel sheets with a laser beam according to an embodiment of the present invention; and

FIG. 2 is a fragmentary perspective view showing a conventional method of welding galvanized steel sheets with a laser beam.

Best Mode for Carrying Out the Invention

An embodiment of the present invention will hereinafter be described with reference to the drawings.

FIG. 1 shows a method of welding galvanized steel sheets with a laser beam according to an embodiment of the present invention. A galvanized steel sheet 1 has plated zinc layers 2, 3 deposited on its opposite surfaces, and another galvanized steel sheet 4 also has plated zinc layers 5, 6 deposited on its opposite surfaces. Each of the galvanized steel sheets 1, 4 has a thickness of 1 mm, and each of the zinc layers 2, 3, 5, 6 has a thickness ranging from about 30 to 40 μm.

An intermediate layer 7 is interposed between the galvanized steel sheets 1, 4. The intermediate layer 7 is formed by spraying a solution of carbon graphite over the galvanized steel sheet 4. Alternatively, the intermediate layer 7 may be made of a carbon-base surface absorber.

A laser beam 8 is applied to weld the galvanized steel sheets 1, 4 to each other. The laser beam 8 is produced at an output level of 2.8 KW in a continuous wave mode. The welding speed is sligtly lower than the conventional welding speed, and is specifically about 2.5 m/min.

When the galvanized steel sheets 1, 4 are welded by the laser beam 8 under the above conditions, a resulting weld bead 9 has substan-

tially uniform width dimensions, and a porosity count, i.e., the number of cavities formed in the weld bead 9, is substantially 1/10 of the conventional porosity count. Moreover, the mechanical strength of the welded joint is not lowered.

The above welding conditions are given by way of example only, and may be modified depending on other conditions including the pressure under which the galvanized steel sheets 1, 4 are held together, the output level of the applied laser beam, and so forth.

The above method of welding galvanized steel sheets with a laser beam may be combined with a robot, and such a combination may be used as a laser beam welding robot for welding automobile body panels or the like.

While the galvanized steel sheets are welded to each other in the above description, a galvanized steel sheet and a steel sheet of another type may also be welded to each other according to the method of the present invention. The intermediate layer, which has been described as being made of carbon graphite, may be of other material. The absorber may be applied by coating.

According to the present invention, as described above, the intermediate layer which suppress evaporation of the zinc layers is interposed between the galvanized steel sheets to prevent porosity from being formed and uniformize the width of the weld bead. The mechanical strength of the welded joint is increased.

Claims

1. A method of welding galvanized steel sheets to each other or a galvanized steel sheet and a sheet of another metal to each other with a laser beam, comprising the steps of:

   forming an intermediate layer for suppressing evaporation of zinc, between said galvanized steel sheets or said galvanized steel sheet and said sheet of another metal; and

   applying a laser beam to said galvanized steel sheet or said sheet of another metal, thereby welding the sheets with the laser beam.

2. A method according to claim 1, wherein said intermediate layer is of carbon graphite or a carbon-base surface absorber.

3. A method according to claim 1, wherein said intermediate layer is sprayed over one of said galvanized steel sheets.

4. A method according to claim 1, wherein said sheets are welded by the laser beam at a speed lower than would be if said intermediate layer were dispensed with.

5. A method according to claim 1, wherein said laser beam is produced in a continuous wave mode (CW).

6. A method according to claim 1, wherein a laser machining head is mounted on the tip end of an arm of a robot, and a welding path is controlled by the robot.

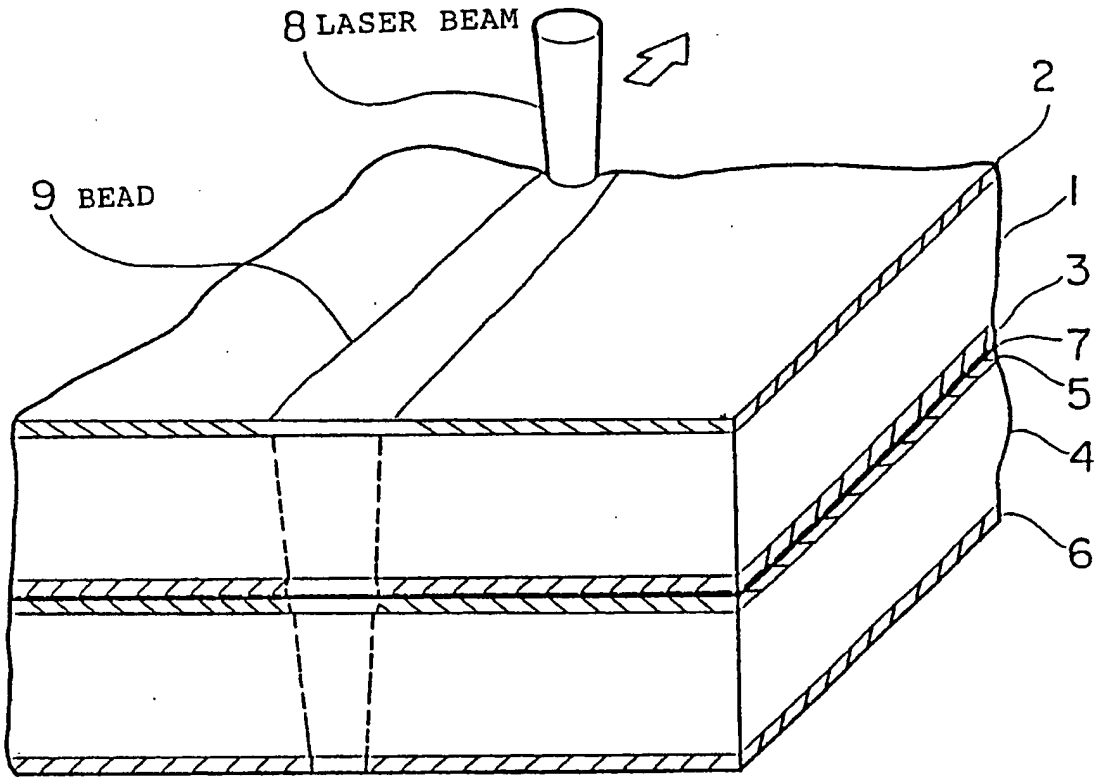

Fig. 1

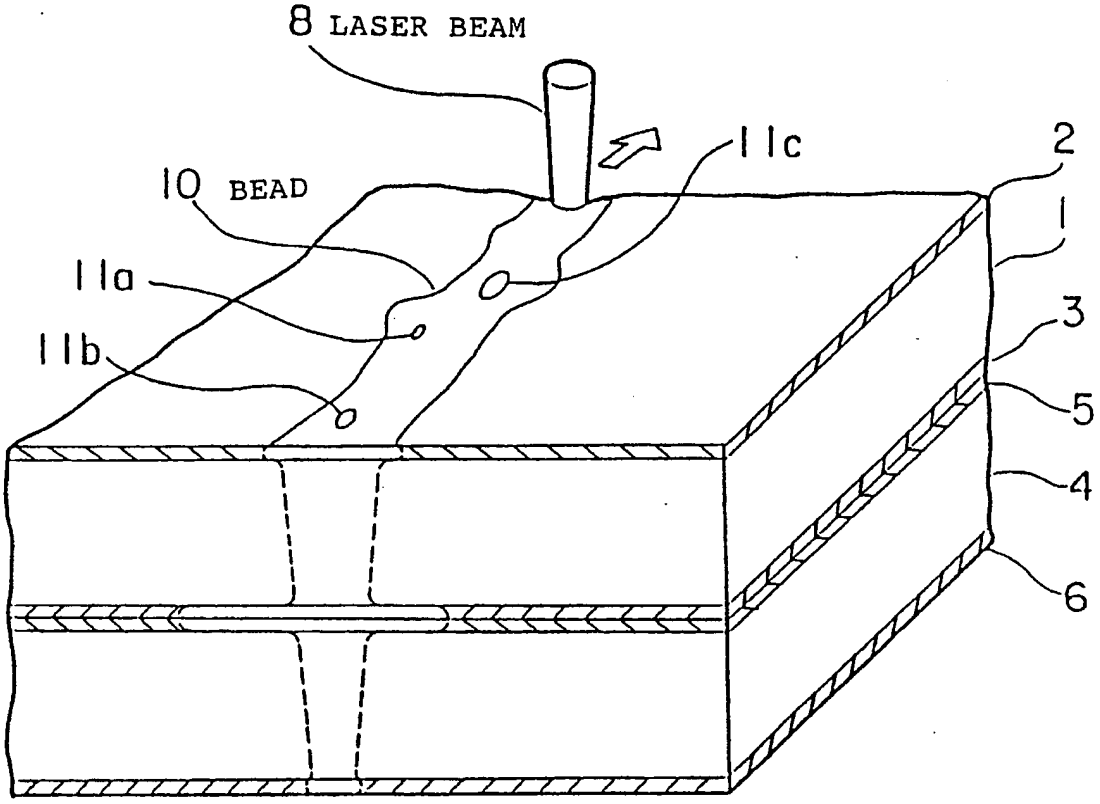

Fig. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/JP90/01464

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl[5] B23K26/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	B23K26/00-26/18

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

Jitsuyo Shinan Koho	1926 - 1990
Kokai Jitsuyo Shinan Koho	1971 - 1990

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	JP, A, 56-84189 (Mitsubishi Heavy Industries, Ltd.), July 9, 1981 (09. 07. 81), (Family: none)	1-6
A	JP, A, 62-296982 (Honda Motor Co., Ltd.), December 24, 1987 (24. 12. 87), (Family: none)	1-6

[10] Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
January 7, 1991 (07. 01. 91)	January 21, 1991 (21. 01. 91)
International Searching Authority	**Signature of Authorized Officer**
Japanese Patent Office	